Key Points

1. Cine MRI has been used for several years to determine if Chiari is blocking normal CSF flow, but its clinical impact is still in question
2. Study looked at 130 Chiari patients and tried to identify predictors of surgical failure
3. Found that normal CSF flow before surgery, frontal headaches, and scoliosis all predicted symptom recurrence
4. Patients with normal CSF flow were 4.8 times more likely to experience surgical failure than those with blocked flow
5. Duration of symptoms, age, amount of herniation were not good predictors
6. Study also showed that more patients experienced symptom recurrence as time went on, indicating the need for long-term follow-up

Definitions

cine MRI - type of MRI which can show the flow of CSF

occipital - referring to the back of the head

posterior fossa - depression in the back of the head where the cerebellum is located

scoliosis - abnormal curvature of the spine

cerebellar tonsils - portion of the cerebellum located at the bottom, so named because of their shape

cerebellum - part of the brain located at the bottom of the skull, near the opening to the spinal area; important for muscle control, movement, and balance

cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

Chiari malformation I - condition where the cerebellar tonsils are displaced out of the skull area into the spinal area, causing

Using Cine-MRI To Predict Surgical Outcome

August 20, 2006 -- A recent publication in the journal Neurosurgery indicates that cine MRI, which can show the flow of cerebrospinal fluid (CSF), may be useful for predicting who will benefit from decompression surgery.

Because Chiari often blocks the natural flow of CSF from the brain into the spinal area and back, doctors have used cine MRI for several years as part of their diagnostic arsenal. However, despite its growing prevalence, some surgeons have questioned its true clinical value.

The subject is ripe for debate because, as this publication has reported several times, there is no objective criteria for when a Chiari patient should have surgery. Similarly, there is no way, on an individual basis, to say which patients will benefit from surgery and by how much. Rather, a doctor will make a surgical recommendation based upon a variety of factors and tests, including symptoms, a neurological exam, MRI results, cine-MRI, and perhaps most importantly, their own experience and judgment.

With surgical failure rates reported at 20% and higher, the selection of good surgical candidates becomes critical for successful outcomes. It may comes as a surprise to some patients that most people who are evaluated for Chiari actually do not have surgery. In both on, and off, the record conversations, neurosurgeons have reported that they only recommend surgery for about 20%-40% of the patients they see.

Given the subjective nature of the surgical decision, researchers have tried for years to find accurate predictors of surgical outcome. While many surgeons intuitively have felt that CSF flow as demonstrated by cine MRI was important, the report in Neurosurgery offers the strongest evidence to date to support this notion.

The study (McGirt et al.) looked at 130 Chiari patients treated at Duke University between 1997 - 2003. All patients had tonsillar herniations of at least 5 mm, and in fact, the average herniation was 11 mm. The average age of the patients was 16, but the group included both children and adults. There were slightly more females than males, and 35% of the group also had syrinxes. The most common symptom was occipital headache, but sensory deficits, frontal headaches, and neck pain were also prevalent (see Table 1).

A patient database of demographic and symptom information was created and every patient was given a cine MRI before surgery. Based on the cine MRI, patients were classified as having either normal or abnormal CSF flow. Not surprisingly, 81% of the group had abnormal flow, with 43% (of the total) showing complete blockage, and 38% showing some reduction. Conversely, 19% of the patients were classified as having normal CSF flow preoperatively.

All patients underwent decompression surgery and were evaluated one month, one year, and if possible, two years after surgery. At the one month follow-up, 89% of the patients were considered to have had successful treatment. It should be noted, however, that this study - like so many others - did not clearly define success, and this continues to be a major problem with Chiari research. Interestingly, symptoms started coming back for some people as time went on, and by the one year mark, only 71% were still considered a success. This dropped even further, to 67%, by the two year follow-up.

When the researchers applied statistical analysis to their database of information, they found that age, duration of symptoms, and size of herniation did not predict who had successful outcomes. They did find, however, that the CSF flow - as measured by cine MRI - was a good predictor of outcome. Specifically, they found that patients with normal CSF flow prior to surgery were 4.8 times more likely to have a failed outcome after surgery than patients with blocked or restricted flow (see Table 2). Similarly, patients without CSF flow improvement after surgery were twice as likely to have poor surgical outcomes.

In addition to CSF flow, they also found that frontal headaches (as opposed to the classic back of the head Chiari headache) and scoliosis were significant predictors of outcome. Specifically, patients with a frontal headache as a primary symptom were four times more likely to have a poor surgical outcome than patients without this symptom.

Similarly, those with significant scoliosis were nine times more likely to have surgery fail. However, in a published comment after the article, Dr. Richard Ellenbogen tries to put the scoliosis finding in perspective, " [people] should not be misled by the presence of scoliosis as a risk factor for failure of surgery...These are mostly Chiari patients with syringomyelia who require surgery to prevent progression of their disease. There should be little question about the indication for surgery in this [group]."

For those patients with syringomyelia, surgery resolved (or significantly reduced) the syrinx 65% of the time, while the syrinx was decreased slightly for the remainder of the group. Highlighting our lack of understanding

compression of brain tissue and disruption of CSF flow

decompression surgery - general term used for any of several surgical techniques employed to create more space around a Chiari malformation and to relieve compression

Source

McGirt MJ, Nimjee SM, Fuchs HE, George TM. Relationship of cine phase-contrast magnetic resonance imaging with outcome after decompression for Chiari I malformations. Neurosurgery. 2006 Jul;59(1):140-6

regarding how and why syrinxes form, the researchers found that there was no connection between the severity of CSF flow blockage and whether syrinxes resolved.

The results from this study are consistent with earlier research which found that patients with significant CSF blockage improved the most. Given the direction this evidence is leading, it would be interesting to combine this type of work with research measuring the posterior fossa dimensions of patients. As the authors point out, it is natural to assume that those Chiari patients with a small posterior fossa are likely to have more CSF blockage, and, at least according to this study, respond better to surgery.

While this study does provide evidence of the clinical utility of cine MRI, it is still not clear that it is an objective measure. For example, the authors do not provide details as to what qualified as normal and abnormal CSF flow, and as previous research has indicated, natural CSF velocities may change with age.

In addition, as noted previously, the authors did not provide a clear definition of what was a successful outcome versus a failed outcome. Until the Chiari community develops a standard, comprehensive outcome measure, it will remain difficult to compare the results of one study to another.

Although the authors do not discuss this, one of the most striking findings was the rapid drop-off of what was considered successful surgery as time went on. A procedure with an 89% success rate may be considered good, but the fact that this dropped to just 67% in two years is troubling. At one month post-op, most patients have not yet tried to resume what would be considered a normal life, with work, school, family responsibilities, social activities, etc. It may be that patients symptoms are relieved immediately following surgery, but they find that as they try to move forward with life, they are not able to do so without symptoms.

One has to wonder how successful current Chiari treatments are 5 to 10 years later. Most outcome type publications only follow patients for 1-2 years at the most, meaning that they may not be providing an accurate picture of what life is really like for patients trying to live with Chiari years after decompression surgery.

Table 1
Most Common Symptoms (130 Patients)

Symptom	% of Patients
Occipital Headache	49%
Sensory Deficit	34%
Frontal Headache	31%
Neck Pain	30%

Table 2
Predictors of Symptom Recurrence After Surgery

Predictor	Increased Risk Of Failure
Normal CSF Flow	4.8X
Frontal Headache	4X
Scoliosis	9X

Note: Increased risk refers to how much more likely someone with one of the predictors was to experience a failed surgery (symptom recurrence) than someone without that predictor. In other words, a patient with normal CSF flow pre-op was 4.8 times more likely to experience surgical failure than a patient with blocked CSF flow.

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